Fisheries and Oceans | Pêches et Océans

MEMORANDUM NOTE DE SERVICE

To / À: FILE

From / De: Jody Mackenzie-Grieve-FCSAP bio

Security Classification - Classification de sécurité: **UNCLASSIFIED**

Our file - Notre référence: **05-HPAC-PA5-00204**

Your File - Votre référence:

Date: **October 26 2010**

Subject / Object: **CLINTON CREEK JCS GENETICS**

INTRODUCTION

Within the Clinton Creek drainage is the Clinton Creek mine. It is an abandoned asbestos mine and is a Federal Contaminated Site (FCSAP) site for which a site closure plan will soon be developed and implemented. DFO has an interest in this site since the creek is considered one of the most productive creeks in the Fortymile watershed for jcs non-natal rearing and over-wintering (confirmed in 2008; von Finster 2009). Because the creek is so important for jcs rearing, DFO staff have completed regular sampling in this creek (2005-2009) to assess fish usage and thermal regime of the creek.

During the summer of 2009, the Dawson District Renewable Resource Council (DDRRC), completed a series of sampling events at Clinton and Mickey Creeks designed to target juvenile chinook salmon (jcs). The work was part of the DDRRCs habitat restoration work (CRE-06-09) and was funded through the Restoration and Enhancement Fund administered by the Yukon River Panel (YRP); the work in 2009 was the fourth year of this project. The intent of the DDRRC's work on Clinton Creek was to restore jcs to rearing habitats upstream of temporary obstructions (beaver dams, in this case) in an effort to increase the amount of habitat available to these fish. The intent of the work in Mickey Creek was to restore jcs to habitats upstream of the culvert on the Clinton mine access road. In collaboration with the DDRRC, a jcs sampling project to collect DNA was led by Al von Finster (Fisheries & Oceans Canada (DFO), Resource Restoration Biologist). The following memo describes the results of the DNA collection work completed by DFO.

METHODS

Sampling in 2009 was completed in Clinton Creek as well as in Mickey Creek. Mickey Creek discharges to the Fortymile River almost directly opposite Clinton Creek. It is a much colder creek (maximum summer temperature observed during summers of 2007 & 2009: 8.2°C, based on datalogger files) than is Clinton creek (maximum summer temperature observed during summers of 2007 through 2009: 25.4°C, based on datalogger files) in part as water is not retained in a lake as it is

Canada

in Clinton Creek (Hudgeon Lake). Previous work completed by DFO staff showed that Mickey Creek is used as a rearing stream for jcs and is used by other species as well. Usage by smaller fish is restricted in some years to approximately 600m downstream of the culvert under the Clinton mine road (von Finster 2005). Mickey Creek was sampled to allow some (limited) comparison between two very different jcs non-natal rearing tributaries to the Fortymile River.

In Clinton Creek, the DDRRC project consisted of capturing jcs near the mouth of Clinton Creek (Station 4) and transporting them to the minesite area (near Station 2A: immediately upstream of the mouth of Wolverine Creek; WPT: N 64 26.946 W 140 42.421) for release. The intent of this relocation effort was to increase the amount of rearing habitat available to jcs (upstream movement by jcs is restricted by a series of beaver dams in lower Clinton Creek). Although jcs were not all individually marked, it is likely that most jcs captured at the upper station for the purposes of DNA collection had been released near the capture site as part of the DDRRC project. Typically, jcs captured near the mine site are generally larger than jcs captured at the mouth when the two sites are sampled at the same time (e.g., von Finster 2005). It is generally assumed that jcs captured near the mouth of Clinton Creek are 'new arrivals' to the creek. In Mickey Creek, jcs were captured below the culvert under the Clinton mine access road, and were then released upstream of the culvert. Capture and release events occurred 5 times between July 27 and August 8, 2009 in both Clinton and Mickey Creeks (Fraser 2009).

Both Mickey and Clinton Creeks were sampled for DNA collection on two occasions (August 12-13 and September 15-16, 2009). Mickey Creek was sampled immediately downstream of the culvert on both occasions. Clinton Creek was sampled slightly upstream of the confluence with the Fortymile River (WPT: N 64 24.210 W 140 35.839; also known as Station 4 (2005) in DFO files), and was also sampled near the mine site area (Stations 2 (near the ford) WPT: N 64 26.979 W 140 42.979 and 2A (in Clinton Creek upstream of confluence with Wolverine Creek) WPT: N 64 26.920 W 140 42.197) .

To target 0+ jcs, baited (with Yukon River basin chinook salmon roe-as per YRP protocol) minnow traps were set (overnight; approximately 24 hrs) at fixed monitoring stations within Clinton and Mickey Creeks. As part of this sampling, biological data as well as genetic samples were collected.

The biological sampling consisted of length and weight measurements of captured jcs. For length measurements, a standard (30cm) measuring board was used (available from many scientific supply houses), and weights were obtained using a calibrated balance (PV-200 Professional pocket scale) placed on a level surface. All fish were blotted to remove surface water prior to being weighed. Length-frequency, relative length frequency and condition analyses were completed on the biological data for jcs. The length-frequency analysis consisted of assignment of fish, based on their lengths, to various length 'bins' developed to represent the range of lengths observed in the data over the 2009 sampling period. The length ranges within these bins were equal, but were arbitrarily determined. The relative length frequency analyses were completed to assess the relative contribution (%) of the various length ranges (bins) to the overall catch. Condition analyses consisted of linearizing the data using a log transformation of length and weight data, plotting the data, and then regressing fork length on mass. Compared to the 'index' approach (e.g., Fulton's condition factor), our approach did not assume isometric growth and is considered to be a more accurate method of examining the weight-length relationships for fish populations (Cone 1989).

For genetic analysis, fin clips were completed (anal fin tissue) and stored in 100% ethanol in 2mL vials, as per Pacific Biological Station (PBS) recommendations (personal communication from T. Beacham to A. von Finster, spring 2009). At the time of capture, each fish was given a unique identifier such that genetic information obtained could be linked to biological information for each individual fish. These samples were sent to the Beacham lab at PBS in December of 2009. Results were obtained from PBS in March 2010.

The Beacham lab at PBS typically employs microsatellite analysis to complete stock identifications. The baseline for Yukon River chinook has been in development for the last several years. To develop the necessary baseline, the goal was to obtain 200 samples from chinook on the spawning grounds from known (major) sites within the various drainage basins. This sample size yields a higher probability of correctly assigning a sample of unknown origin to its stock of origin (P. Milligan, Fisheries & Oceans Canada, personal communication) compared to smaller sample sizes. Unfortunately, the baseline is still considered to be limited for most stocks (P. Milligan, Fisheries & Oceans Canada, personal communication), and only the larger Yukon River chinook stocks are currently part of the baseline. For example, only 5 spawning populations were sampled to develop the baseline for the Stewart River, although many more populations may be spawning at other sites within the drainage. It is possible, therefore, for chinook to be incorrectly assigned (or assigned with a very low probability) to a stock of origin because the actual stock of origin is not adequately represented in the baseline. Assignment of an unknown sample to a stock of origin is essentially a probability applying bootstrapping / Monte Carlo analysis completed by the computer program (adapted version of BAYES) used at PBS (John Candy, Fisheries & Oceans Canada, PBS, personal communication).

RESULTS AND DISCUSSION

Clinton Creek

The majority of the jcs (43/46) captured in August at the lower sampling station (Station 4) were of 'Yukon main' origin (Figure 1). The 'Yukon main' zone of the Yukon River is between the mouth of Tatchun Creek and the mouth of the Pelly River. The sampling used to develop the baseline for that zone, however, was only completed at one site in the Minto area (P. Milligan, Fisheries & Oceans Canada, personal communication). There may be other spawning sites within this section of the Yukon River which are not included in the current baseline. A small portion of jcs appeared to be of Teslin origin (1/46), Big Salmon origin (1/46), and Hoole origin (1/46).

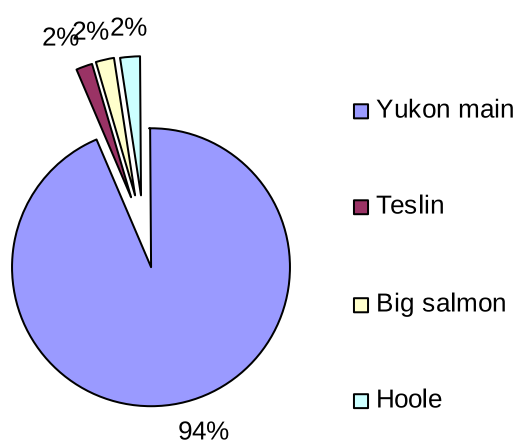

Figure 1. Origin of jcs captured in Clinton Creek August 12-13, 2009 from Clinton Creek upstream of the confluence with the Forty Mile River.

On this occasion, sex ratios of captured jcs were equal (23 males:23 females). Jcs between 66 and 70 mm were most common (Figure 2); this length class accounted for more than 35% of the jcs sampled (Figure 3). Mean length of jcs overall (not stock-specific) was 69.8 mm (SE: 0.9).

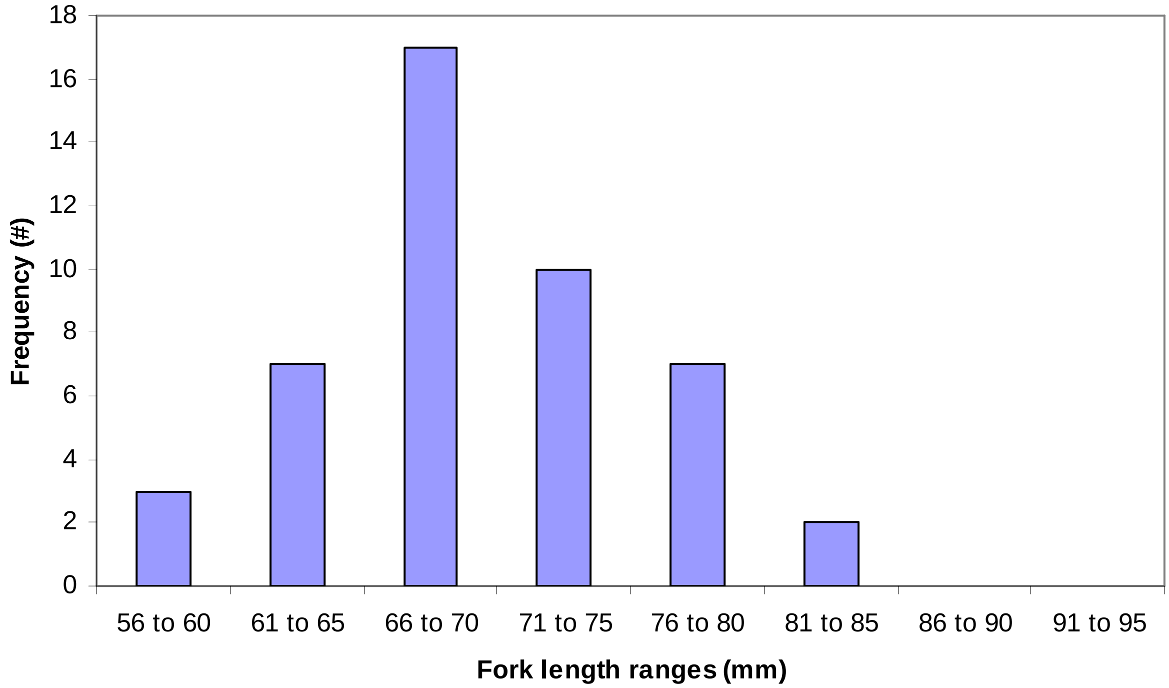

Figure 2. Length-frequency distribution of jcs captured in Clinton Creek August 12-13, 2009 near the confluence of Clinton Creek with the Forty Mile River.

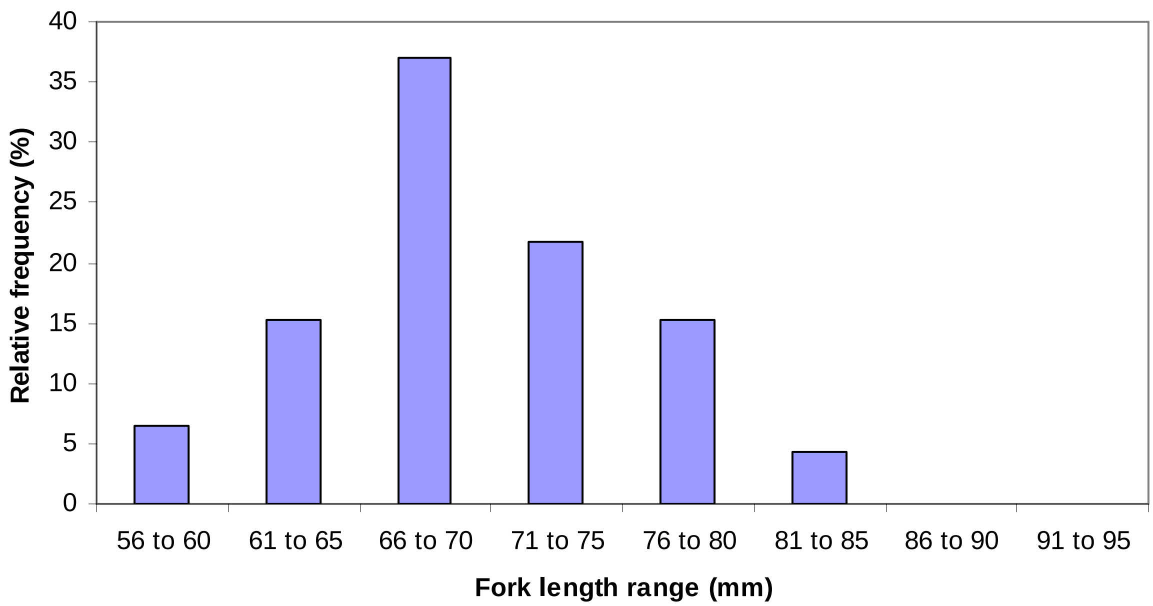

Figure 3. Relative length frequency of length ranges for jcs captured in Clinton Creek August 12-13, 2009 near the confluence of Clinton Creek with the Forty Mile River.

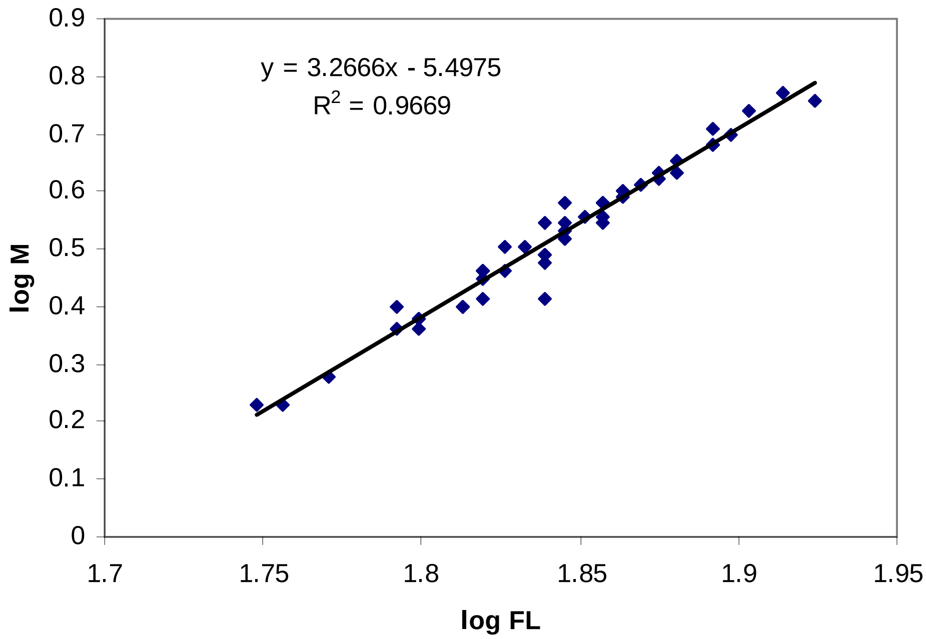

Figure 4. Condition of jcs captured in Clinton Creek August 12-13, 2009 near the confluence of Clinton Creek with the Forty Mile River.

To simplify comparison between sampling periods, condition data (length and mass data) were linearized by log transformation and graphed (Figure 4).

August samples obtained from the mine site area (Station 2) were predominantly of 'Yukon main' origin (37/44). Other stocks of origin included Teslin (3/44), Little Kalzas (2/44), Nordenskiold (1/44) and Big Salmon (1/44) (Figure 5).

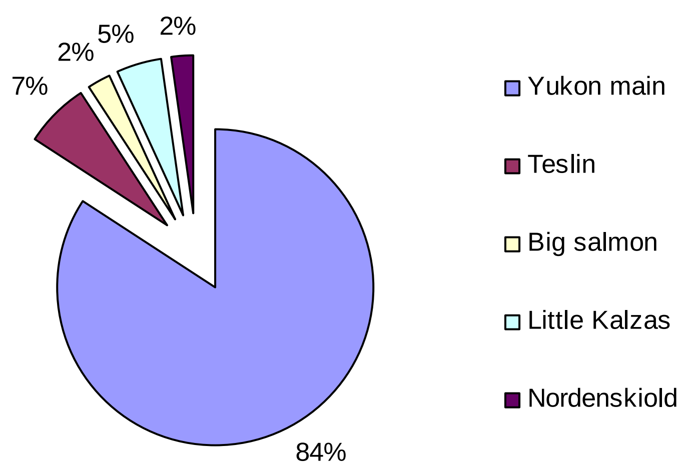

Figure 5. Origin of jcs captured in Clinton Creek August 12-13, 2009 from the minesite.

Within the dataset, there appeared to be a female bias (25/44 samples), but it was not statistically significant (χ^2=0.82; df=1; P>0.05). Jcs between 66 and 70 mm were most common (Figure 6), however there was one fish that was larger than any of those captured at this time of year at the lower station (Figure 2). Similar to the lower sampling station, jcs in the 66 to 70 mm length class accounted for more the 35% of jcs captured at this site at this time of year (Figure 7). Mean length of jcs at this time and location was 69.5mm (SE: 0.8).

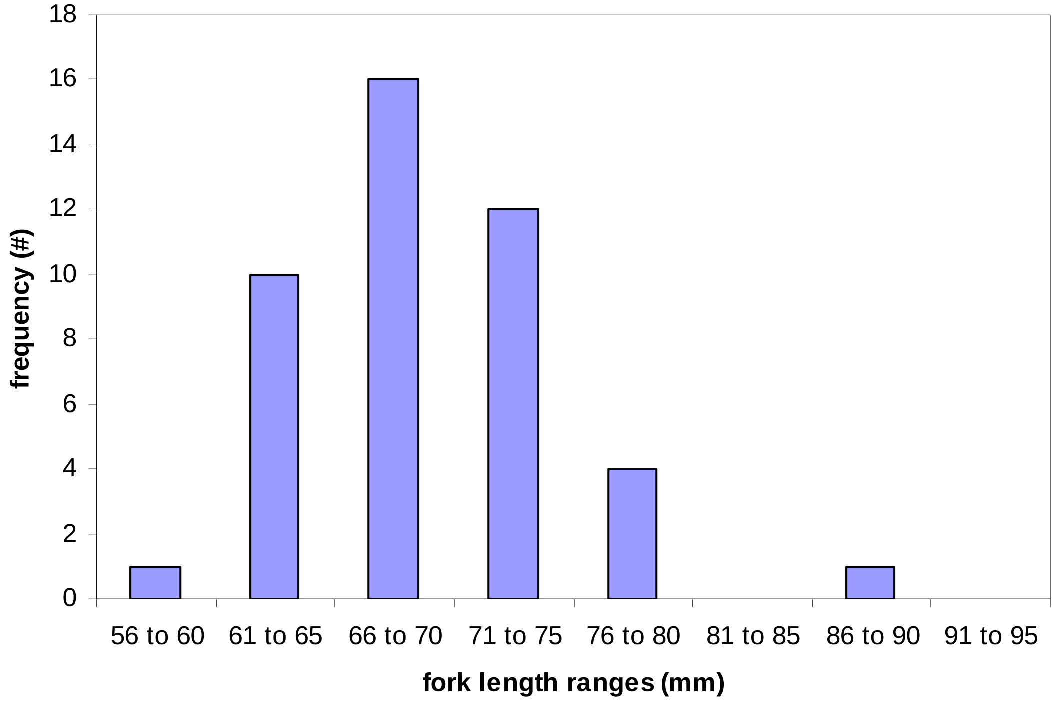

Figure 6. Length-frequency distribution of jcs captured in Clinton Creek August 12-13, 2009 at the mine site.

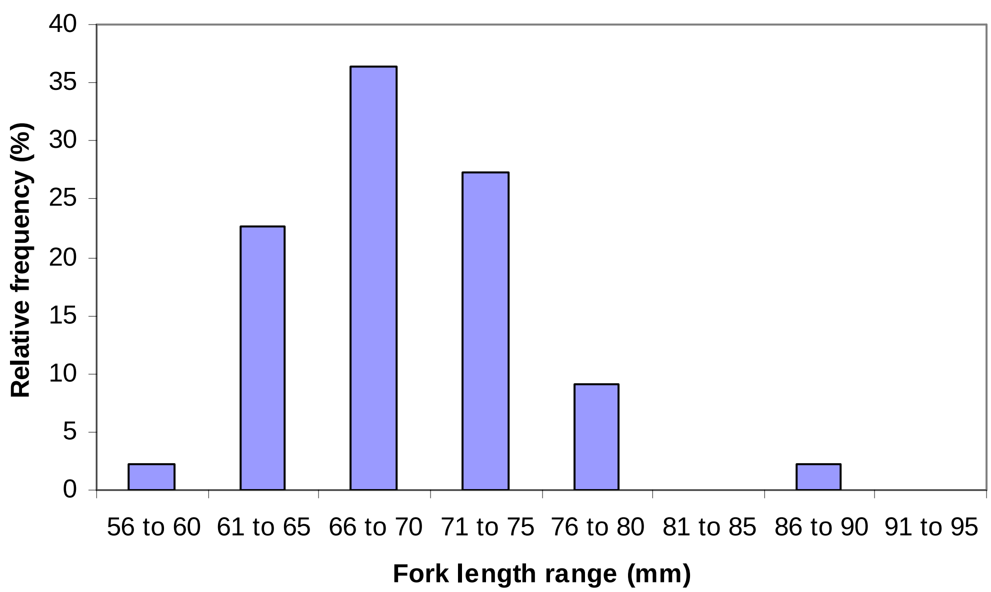

Figure 7. Relative length frequency of jcs fork length ranges from the minesite area August 12-13, 2009 in Clinton Creek.

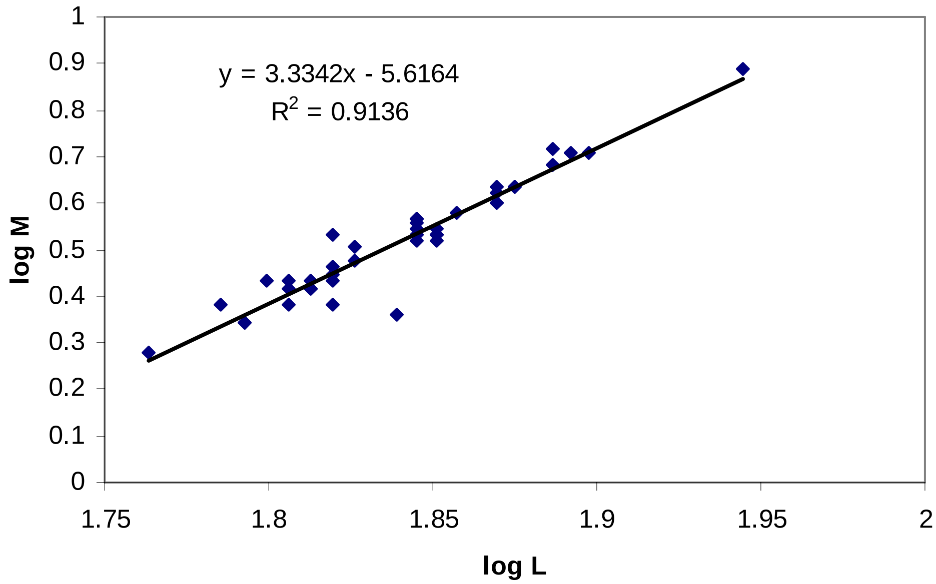

Figure 8. Condition of jcs captured in Clinton Creek August 12-13, 2009 near the mine site.

Although the slope of the log transformed length-mass regression indicated that the slope was very similar to that observed for the lower station (3.267; Figure 4), the slope of the minesite data was slightly more steep, suggesting a higher growth rate at the minesite station compared to the lower station.

September samples obtained from the lower station (Station 4) were predominantly of 'Yukon main' origin (38/49), followed by Teslin (7/49), Mayo (3/49) and Chandindu (1/49) (Figure 9).

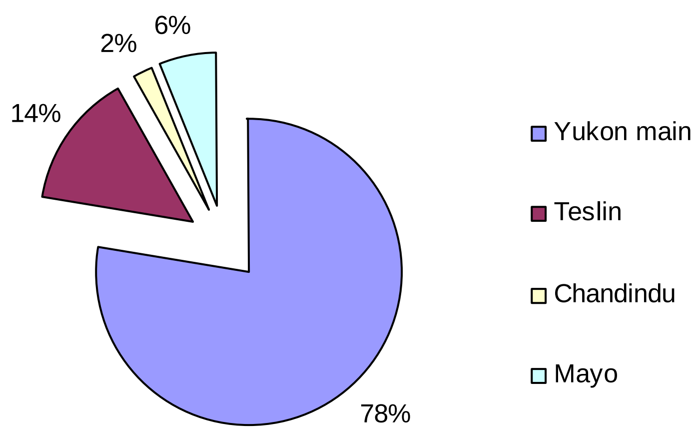

Figure 9.Origin of jcs captured in Clinton Creek September 15-16, 2009 upstream of the confluence of Clinton Creek with the Forty Mile River.

Within the dataset there was a female bias (33/49) that was statistically significant (χ^2=5.8; df=1; P<0.05). There appeared to be a bimodal length-frequency distribution: peaks appear for the 66 to 70 mm length class, and for the 76 to 80 mm length class (Figure 10). The smaller length class accounted for nearly 30% of the fish captured and the larger length class accounted for almost 25% of fish sampled (Figure 11). Mean length of jcs at this time and location was 71.8 mm (SE: 1.0).

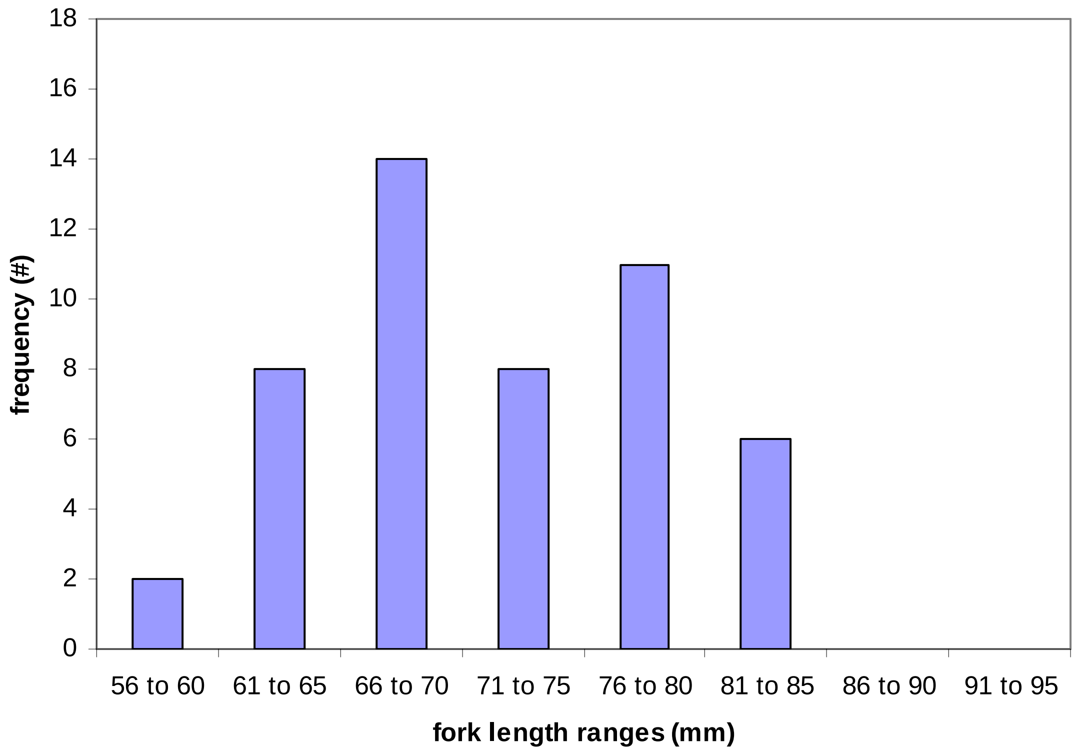

Figure 10. Length-frequency distribution of jcs captured in Clinton Creek September 15-16, 2009 near the confluence of Clinton Creek with the Forty Mile River.

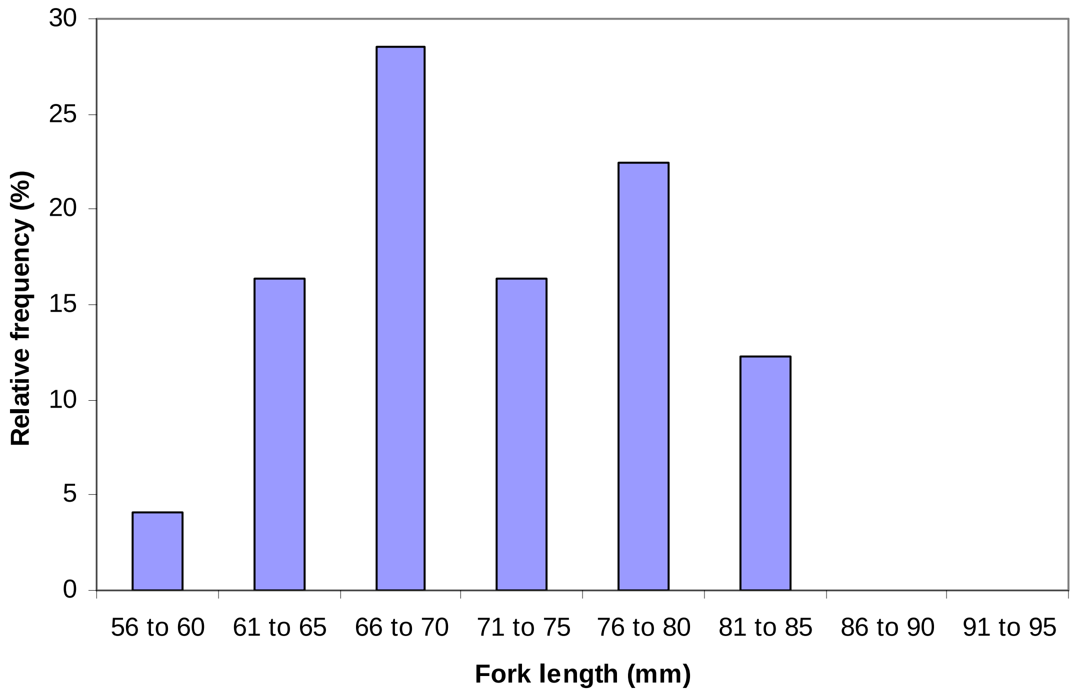

Figure 11. Relative length-frequency distribution of jcs captured in Clinton Creek September 15-16, 2009 near the confluence of Clinton Creek with the Forty Mile River.

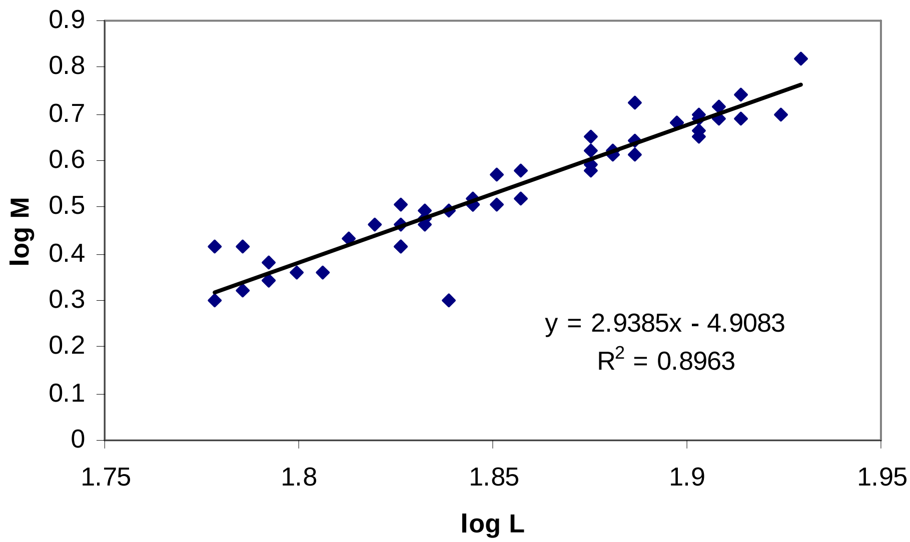

Figure 12. Condition of jcs captured in Clinton Creek September 15-16, 2009 near the confluence of Clinton Creek with the Forty Mile River.

To simplify comparison between sampling periods, condition data (length and mass data) were linearized by log transformation and graphed (Figure 12). Although slopes between sampling periods and locations within Clinton Creek are very similar, the slope from the September sampling near the mouth is slightly less steep than earlier in the year suggesting a slower growth rate.

September samples obtained from the mine site area (Station 2) were predominantly of Yukon main origin (38/46). Other stocks of origin included Teslin 3/46, Big Salmon (1/46), Hoole (1/46), Glenlyon (1/46), Stewart (1/46) and Klondike (1/46) (Figure 14).

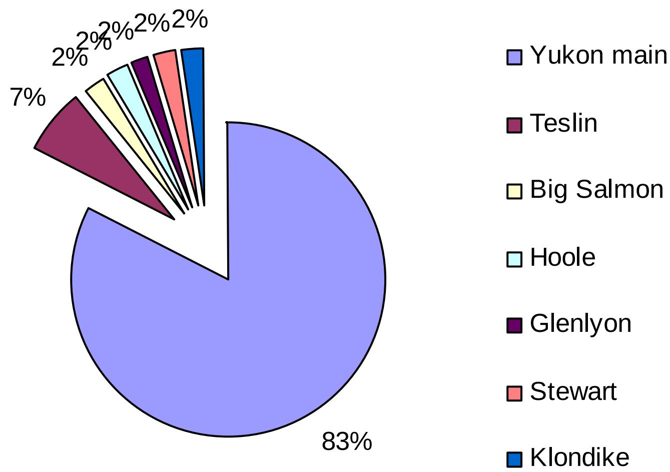

Figure 13. Origin of jcs captured in Clinton Creek September 15-16, 2009 from the minesite.

Within the dataset there appeared to be a female bias (25/46 samples), but it was not statistically significant (χ^2=0.34; df=1; P>0.05). Most jcs captured were within the 76-80 mm length range (Figure 14) which was the most common length range during the sampling period, and accounted for about 17% of the jcs captured (Figure 15). A couple of larger jcs were also identified (91-95 mm range). Compared to other sampling occasions and locations within Clinton Creek in 2009, these jcs were the largest. Mean length of jcs at this time and location was 78.3mm (SE: 0.7)

To simplify comparison between sampling periods, condition data (length and mass data) were linearized by log transformation and graphed (Figure 16). Although slopes between sampling periods and locations within Clinton Creek are very similar, the slope from the September sampling near the minesite is slightly higher than at other locations at other times of year suggesting that jcs had higher growth rates around the time of this sampling event.

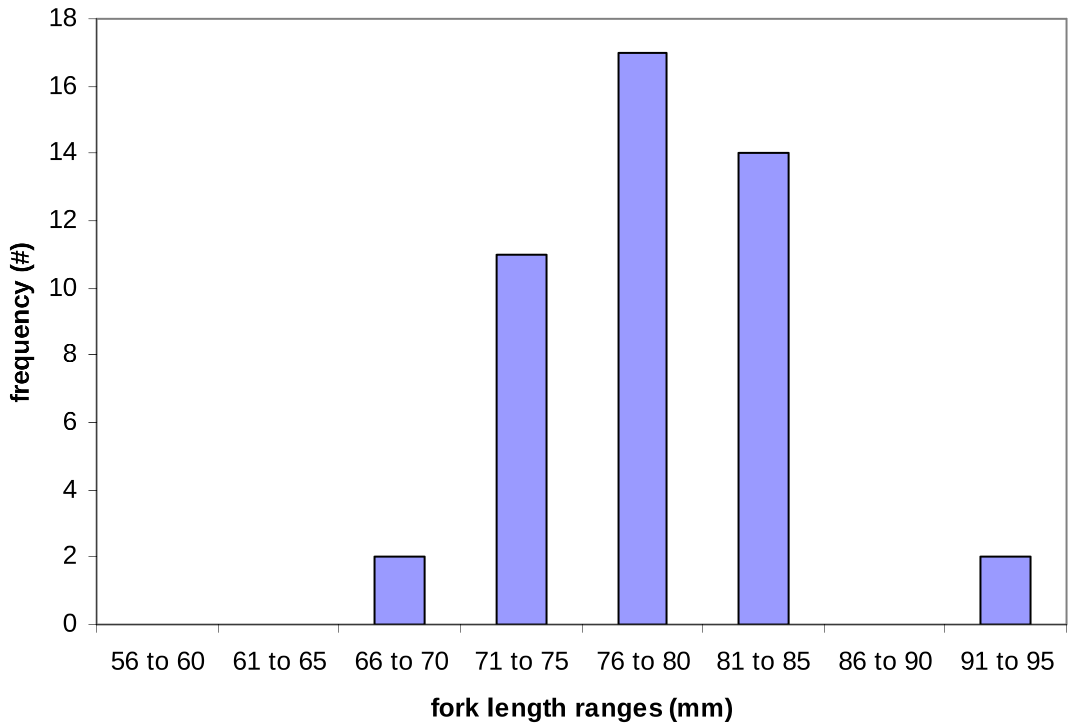

Figure 14. Length-frequency distribution of jcs captured in Clinton Creek September 15-16, 2009 at the mine site.

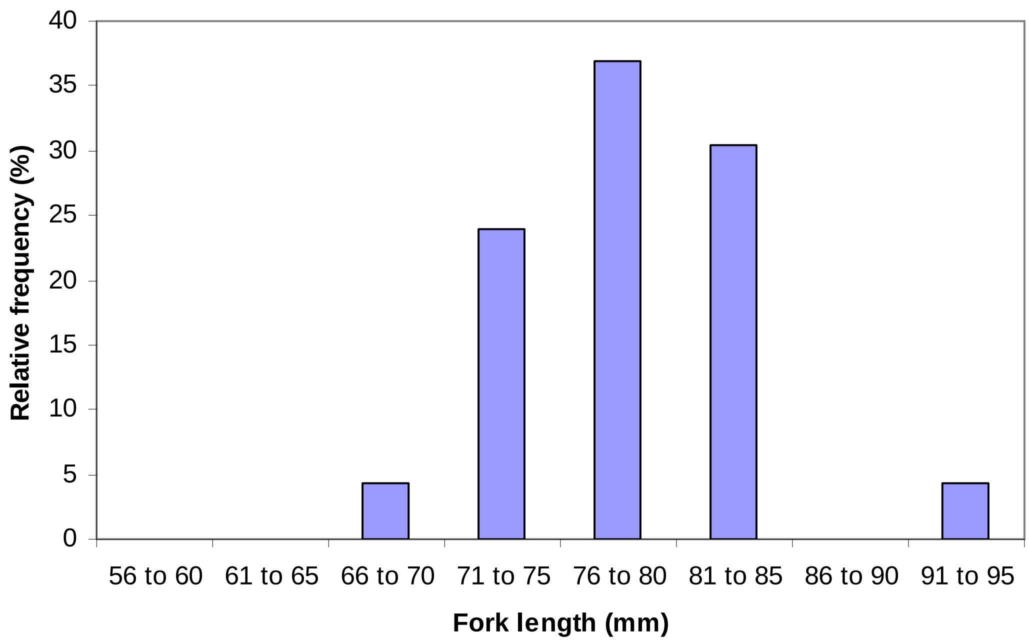

Figure 15. Relative length-frequency distribution of jcs captured in Clinton Creek September 15-16, 2009 at the mine site.

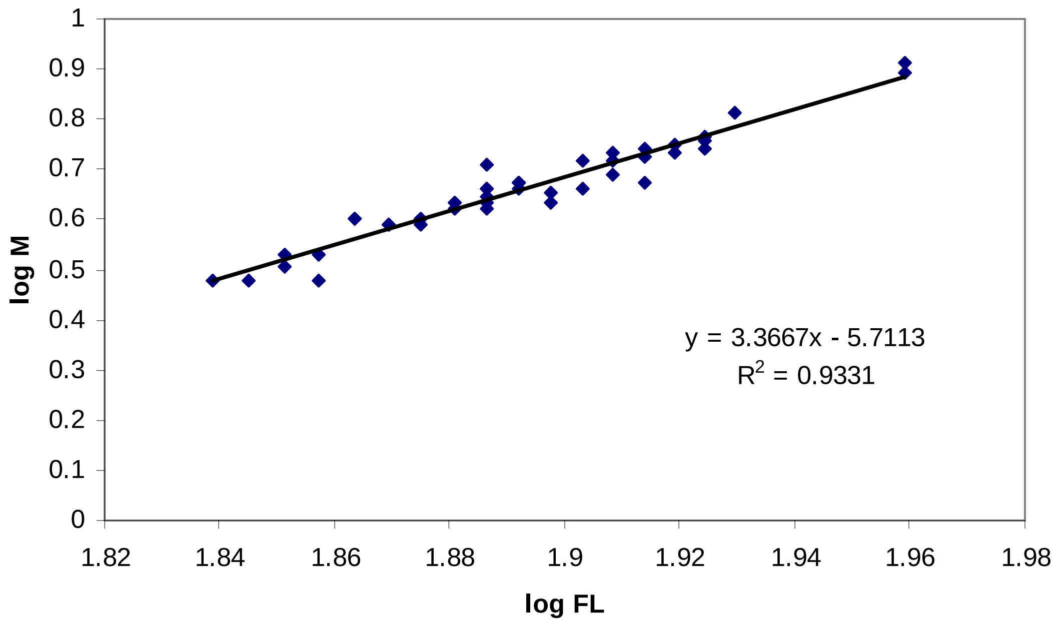

Figure 16. Condition of jcs captured in Clinton Creek September 15-16, 2009 near the mine site.

Mickey Creek

Captures from Mickey Creek were much lower than from Clinton Creek and the small samples sizes from Mickey Creek posed a challenge for analyses and meaningful comparisons with Clinton Creek. Jcs captured from Mickey Creek in August were primarily of 'Yukon main' origin (3/4) although there was one fish assigned to a Glenlyon origin (Figure 17).

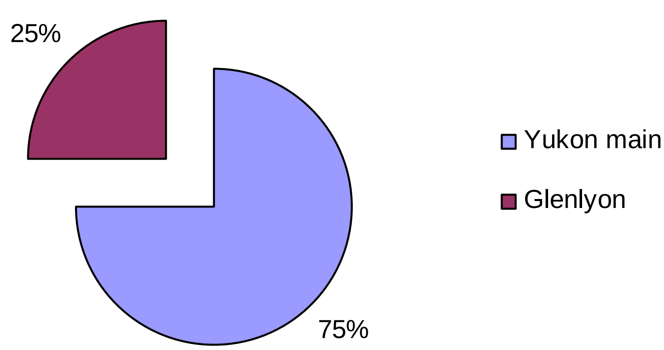

Figure 17. Origin of jcs captured in Mickey Creek August 12-13, 2009.

Sex ratios of jcs captured appeared to be male biased (3/4) but this result was not statistically significant (χ^2=1; df=1; P>0.05). Very few jcs (n=4) were captured in Mickey Creek in August. The lengths of these fish varied widely (Figure 18), they were equally represented in 4 of the defined length classes (Figure 19). Mean length of jcs at this time and location was 75.0 mm (SE: 3.7). Although the sample size was small, these fish were, on average, smaller than those captured at Station 2 (78.3 mm; near minesite) but larger than those captured at Station 4 (71.8 mm; near mouth) in Clinton Creek in early August.

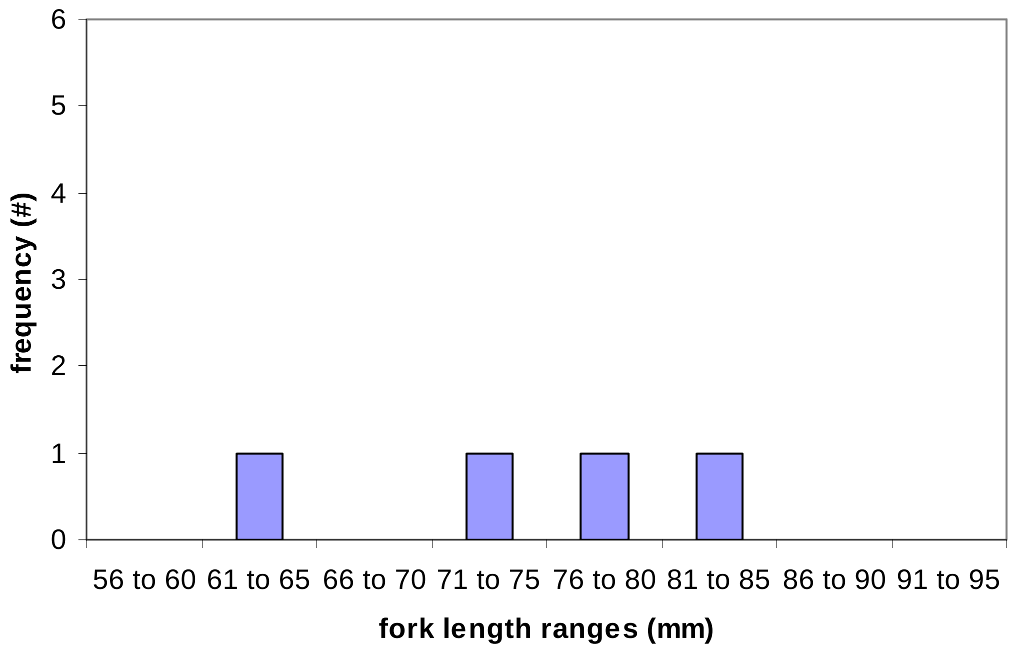

Figure 18. Length-frequency distribution of jcs captured in Mickey Creek August 13-14, 2009.

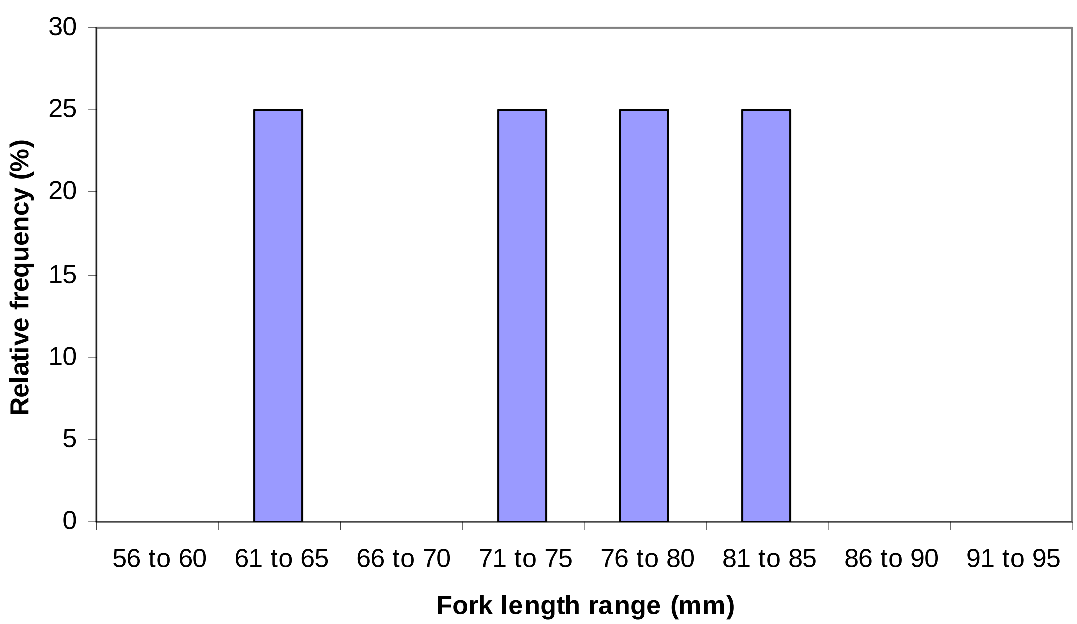

Figure 19. Relative length-frequency distribution of jcs captured in Mickey Creek August 13-14, 2009.

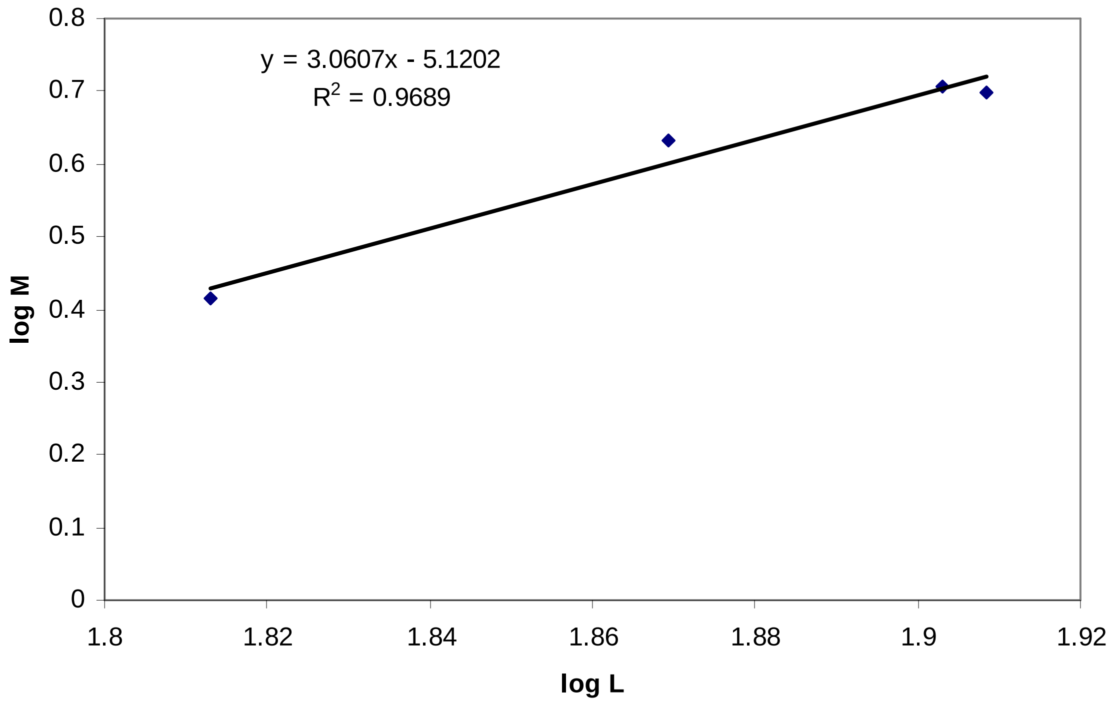

Figure 20. Condition of jcs captured in Mickey Creek August 13-14, 2009.

To simplify comparison between sampling periods, condition data (length and mass data) were linearized by log transformation and graphed (Figure 20). Although slopes from the Clinton Creek dataset and the Mickey Creek data set for mid August were very similar, data suggests that growth rates were lower in Mickey Creek (3.061) compared to Clinton Creek (station 4: 3.267; station 2: 3.334) in mid August.

Jcs captured from Mickey Creek in September were primarily of 'Yukon main' origin (4/7) although there was one fish (1/7) assigned to a Teslin origin, and there were two fish (2/7) assigned to a Nordenskiold origin (Figure 21).

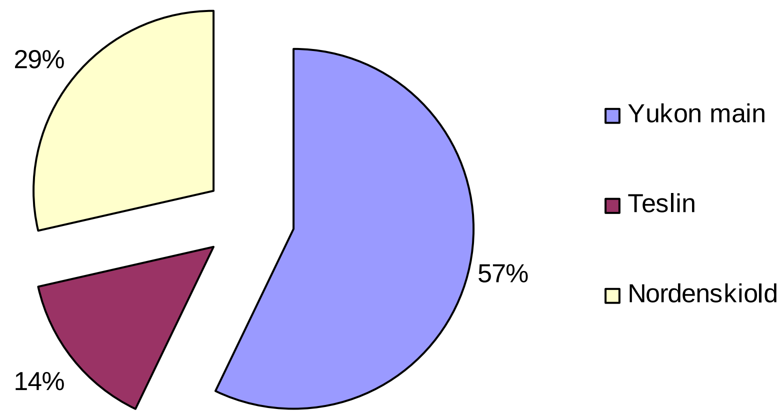

Figure 21. Origin of jcs captured in Mickey Creek September 15-16, 2009.

Sex ratios of jcs captured were not significantly different from a 1:1 ratio (4 females: 3 males) (χ^2=0.14; df=1; P>0.05). The most common jcs length class was 76-80mm (Figure 22) and captures within this length class accounted for approximately 70% of jcs captured (Figure 23); this was also the most common length class for jcs captured in Clinton Creek at the same time of year (Figure 14). Mean length of jcs captured at Mickey Creek in September was 82.3mm (SE: 2.3) which was larger than at either Station 4 (71.8 mm) or Station 2 (78.3 mm) in Clinton Creek.

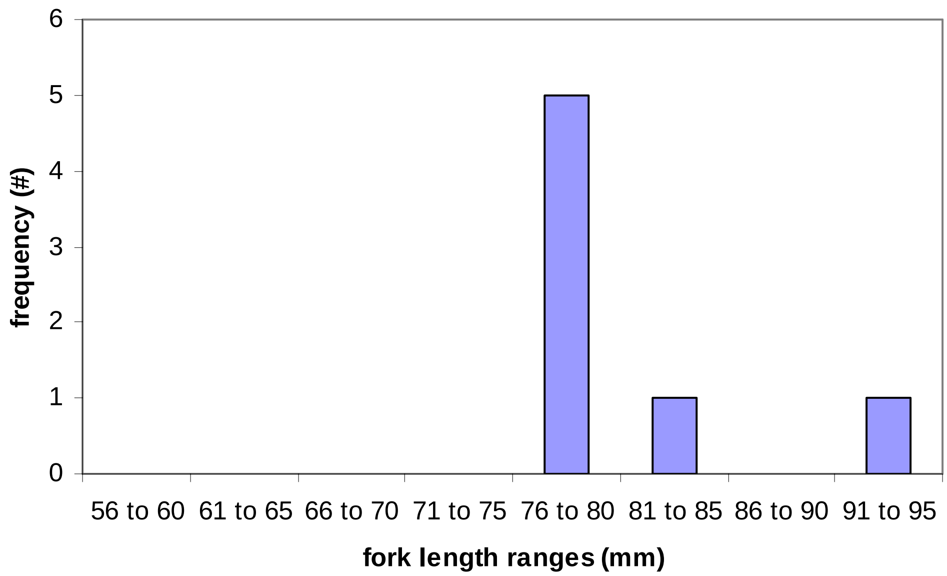

Figure 22. Length-frequency distribution of jcs captured in Mickey Creek September 15-16, 2009.

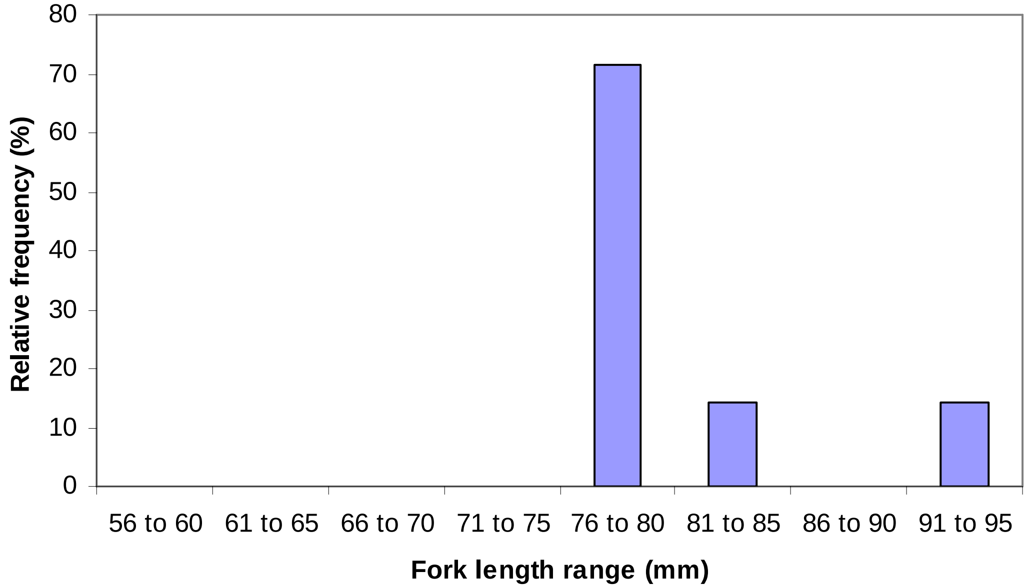

Figure 23. Relative length-frequency distribution of jcs captured in Mickey Creek September 15-16, 2009.

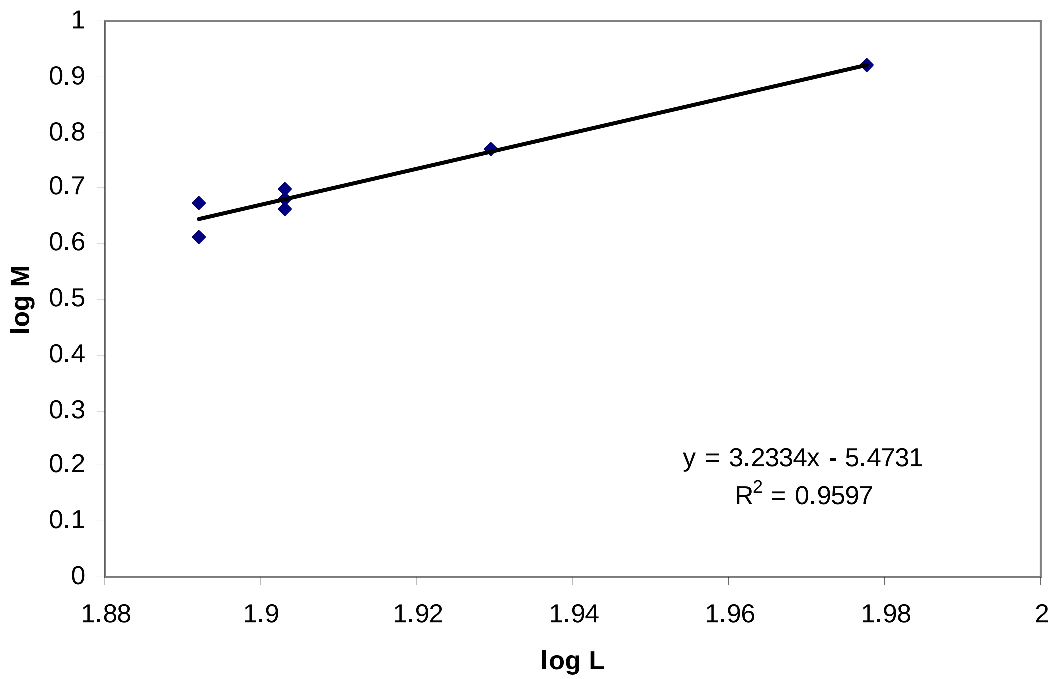

Figure 24. Condition of jcs captured in Mickey Creek September 15-16, 2009.

To simplify comparison between sampling periods, condition data (length and mass data) were linearized by log transformation and graphed (Figure 24). Although slopes from the Clinton Creek dataset and the Mickey Creek data set for mid September were very similar, data suggests that growth rates were slightly higher in September Mickey Creek samples (3.233) compared to August Mickey Creek samples (3.061), yet slightly lower than September Clinton Creek samples from the mine (station 2: 3.667).

Although the minimal sample sizes for development of the chinook baseline suggested by PBS have been met for some stocks (e.g., Tatchun Creek, Blind Creek), they have yet to be met for other stocks, and often only one spawning population has been sampled within an area (e.g., 'Yukon Main' samples (between the mouth of Tatchun Creek and the mouth of the Pelly River) were collected from only one population in the Minto area to create the baseline. Every year Fisheries & Oceans Canada continues to collect samples from spawning chinook and this sampling will likely continue for as long as there is funding available for the work. As sampling continues in years to come, the probability of correctly assigning a tissue sample to a stock of origin is likely to increase.

It is normally assumed that jcs captured near the mouth of Clinton Creek are those that have recently moved into the creek. Jcs captured upstream near the mine site have, presumably, been in the creek longer than those at the mouth. In 2009, most of the jcs at the mine site were likely moved there as part of the DDRRC project. Six previously clipped jcs were recaptured at Stations 2 and 2A in September (were clipped in August) as part of the sampling for the work previously described. These jcs were not sampled (clipped) a second time in September: they were processed and released. Individual or batch marking of jcs could allow for more detailed comparisons between growth and residency within Clinton, and perhaps Mickey, Creeks.

In Mickey Creek, sample sizes were very low and as a result, temporal (over the sampling period) and spatial (between Clinton and Mickey Creeks) comparisons are difficult. The stocks of origin common between Clinton and Mickey Creeks included stocks from 'Yukon main', the Teslin River, the Glenlyon River and the Nordenskiold River. No jcs originating from the Big Salmon River, the Little Kalzas River, the Chandindu River, and the Mayo River were sampled in Mickey Creek.

In Clinton Creek, all sampling events contained individuals of 'Yukon main' and 'Teslin' origin. At least at Station 2, the diversity of the jcs appeared to increase over the summer. For example, at Station 2 in August, jcs originated from 4 different stocks, yet in September they originated from 7 different stocks. Only 4 stocks were ever identified in the Station 4 samples. Although sample sizes were much smaller from Mickey Creek, a similar pattern was observed: in August jcs originated from only 2 stocks, yet September samples originated from 3 stocks.

Although the results presented here suggest that the jcs rearing in Clinton Creek are primarily of 'Yukon main' origin, the origin of subdominant groups of jcs appeared to vary over the course of the sampling period, and, although no statistical analyses were completed, their capture in Clinton and Mickey Creeks did not appear to be correlated with natal location (i.e., migration distance). This pattern may or may not be indicative of the out-migration timing of 0+ individuals in 2009. Additional sampling over a series of out-migration periods (including high and low water periods), perhaps from natal creeks as well as in Clinton and Mickey Creeks, would be necessary to further inform this observation. Additional genetic sampling of jcs in Clinton Creek as well as in other creeks in the region could provide information on the relative importance of these various creeks to jcs rearing and overwintering.

Literature Cited

Cone, R.S. 1989. The need to reconsider the use of condition indices in fishery science. Transactions of the American Fisheries Society 118: 510-514.

Fraser, L. 2009. Yukon River North Mainstem Stewardship, CRE-09-06, October 2009. *Prepared by* the Dawson District Renewable Resource Council, *prepared for* the Yukon River Panel. 31p.

Von Finster, A. 2005. Clinton Creek, tributary to the Fortymile River, Yukon River North Mainstem sub-basin- record of 2005 sampling. Dec 6, 2005. Memo report. 8p.

Von Finster, A. 2005. Memo: Report on 2005 sampling of Mickey Creek, tributary to the Fortymile River, a central Yukon stream affected by wildfire. 5p.

Von Finster, A. 2009. Clinton Creek, tributary to Fortymile River, Yukon River North Mainstem sub-basin- record of 2008 activities. 12p.